strands.[30] Verizon is wrong because a forward-looking network would use spare strands for other purposes. Indeed, Verizon's own planned offerings clearly require increased fiber utilization over current levels.

Q. FOR WHAT PURPOSES DOES VERIZON INTEND TO USE "SPARE" FIBER?

A. Verizon intends to use additional fiber for its planned DSL service and for its offering of Dark Fiber. Although Verizon currently does not offer any DSL service over fiber, during discovery in this proceeding, Verizon produced the Litespan 2000 Application Guidelines, which state that **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**

Not only does Verizon's recommended fiber utilization rate ignore the additional fibers that would be required for its planned DSL service, but it also ignores the additional fibers that would be deployed in the future as a result of Verizon's proposed rates for Dark Fiber. This offering would undoubtedly increase Verizon's current fiber utilization. Verizon simply cannot have it both ways. Verizon cannot legitimately contend that its current fiber utilization rate will remain constant in the forward-looking network, while simultaneously taking steps to offer services that will necessarily increase its current utilization of fiber.

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30 *See* Verizon Cost Panel Direct at 110-12.

Q. ARE THERE ANY OTHER SERVICES THAT WOULD BE DEPLOYED ON SPARE FIBERS IN A FORWARD-LOOKING NETWORK?

A. Yes. Typically, business demands for high speed services are satisfied by extending spare fibers from a Remote Terminal location into the building location. For other high speed business services, multiplexers are installed at the CO and RT location on spare available fibers and a sub-set of the capacity is extended into a business location from the Remote Terminal.

Q. ARE SPARE FIBERS AT A REMOTE TERMINAL EVER USED TO UPGRADE THE SITE?

A. Yes. Frequently, larger installations (*e.g.,* CEVs) that contain older stand-alone multiplexer-driven DLC, are augmented or upgraded to newer Next Generation Digital Loop Carrier (NGDLC). Spare fibers are terminated at the site on the newly installed NGDLC equipment.

Q. ON A FORWARD-LOOKING BASIS, WHAT IS AN APPROPRIATE UTILIZATION FACTOR FOR FIBER CABLE?

A. Because the technology is rapidly evolving, fibers will be completely utilized for a variety of transmission services. The key to these advanced systems lies in using the existing fibers. These transmission systems are emerging in the network today, as Dense Wave Division Multiplexing (DWDM) is deployed. It is therefore appropriate to assume a utilization of 100% for fiber cable on a forward-looking basis.

b) Copper Feeder Utilization

Q. DID VERIZON USE THE CORRECT FORWARD-LOOKING COPPER UTILIZATION RATE IN ITS COST STUDY?

A. No. Verizon's cost study uses a 56.9% copper feeder utilization rate which is far too low. As noted above, Verizon's analysis of copper feeder utilization is fundamentally flawed because it inappropriately relies solely on engineering analyses of how much spare capacity to build, and omits the further (economic) analysis of how the cost of that capacity should be apportioned between current and future ratepayers.

Moreover, even if a purely engineering analysis were sufficient for cost attribution, the amount of spare capacity in Verizon's cost studies is inconsistent with standard engineering practices in a forward-looking environment. Verizon's analysis is based on: (1) an erroneous definition of utilization; (2) a flawed analysis of the effects of breakage; (4) an incorrect understanding of the effect of customer churn on the fill factor; and (4) a failure to analyze properly the effect of demand fluctuations and facility relief efforts.

Q. WHAT IS THE PROCESS USED IN THE INDUSTRY FOR DETERMINING WHEN FACILITY RELIEF IS APPROPRIATE?

A. Copper feeder cable is generally relieved close to the time that its capacity will be exhausted. The relief effort will then add sufficient cable feeder to account for three to five years of growth. We have calculated that the minimum utilization rate of a route in the network should be 82% for a route growing at the average growth rate in Verizon's network (3%) – immediately after a relief job if five years of spare capacity are provided.[31] The maximum utilization rate is close to 100% just before a relief effort occurs. We have therefore conservatively assumed an 80% utilization rate.

Verizon's copper feeder cable extends from the Central Office Main Distribution Frame (MDF) to the Feeder Distribution Interface (FDI), or the Serving Area Interface (SAI) as it is sometimes called. In general, the cable facilities are larger at the Central Office end and taper to smaller sizes as they traverse the route to destination FDI(s). The cable is typically monitored at the MDF (Main Frame Fill), in the route (cross-section fill), and at the feeder side of the interface. **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**

When analyzing the plant in these circumstances, the engineer does not necessarily provide for immediate provisioning of new facilities. The engineer may determine that no relief facilities are required or facilities should be rearranged. In general, the engineer will not provide for provisioning of new facilities until close to the time when facilities will be exhausted. Verizon's engineering guidelines state that "Facility relief must be provided prior to the critical exhaust date which is defined as that point in time when the current

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31 If the growth rate of a particular route were more than 3% a year, than a relief job that provided 5 years of spare capacity would bring utilization below 82%. If the growth rate were less than 3% a year, the relief job would bring utilization down to a level that was higher than 82%.

facilities available can no longer support the service demand in a given route."[32] Thus, in the aforementioned example, relief facilities would be provided before the remaining 135 pairs of the non-interfaced cable (900-765) or 90 pairs of the interfaced cable (900-810) are used. If the route is growing at a rate of 3% per year, the critical exhaust date would be approximately 5 years hence for non-interfaced cable or 3+ years for interfaced cable. In either case, the engineer would typically not undertake relief effort but rather continue to monitor the plant until much closer to the critical exhaust date. Typically, the engineer would not begin a relief effort until a year before critical exhaust was likely to occur and the relief effort would be completed less than a year before critical exhaust.

When a relief effort was finally undertaken, the engineer would ordinarily provide for three to five years of growth. Standard industry engineering guidelines state that copper feeder cable should be installed to service all known demand as of the service date of the cable, plus three to five years of growth.[33] Thus, generally accepted engineering practice calls for building sufficient spare pairs to allow reinforcement every three to five years. **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**

The impact of a relief job on utilization rates can be seen from the following example. Assume a Central Office has a major feeder route serving 5,000 lines and that the route is experiencing a growth rate of 3% per year or 150

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[32] Outside Plant Engineering Guidelines, 1998-00397-OSP, (July 20, 1998) at 10.

[33] Feeder Administration, AT&T 916-100-013.

lines (5,000 x 0.03), which, as we explain below, is the average growth in the number of lines in Virginia over the last three years. In such a case, a relief job would be planned to complete sometime before the last 150 lines were used. For the sake of simplicity, assume that the relief cable would complete one year before critical exhaust, when 150 lines of spare remained or when 4,850 lines were working. (This is a conservative assumption because relief jobs typically will not complete until much closer to critical exhaust.) The fill at the time of relief would be 97% (4,850 divided by 5,000). Since typically 3 to 5 years growth is provided when relieving a route (3x150=450, or 5x150=750),[34] a minimum of 600 cable pairs or a maximum of 900 cable pairs would be provided due to manufactured cable sizes. Thus, the fill in the route would decline, at most, from 97% to 82% (4,850 divided by 5,000+900) – and this would be the lowest level of fill over the 5 year period.[35] It comports with our experience that copper feeder utilization can conservatively operate at 80% fill.

Q. IS VERIZON CORRECT THAT THERE IS A MANDATORY SPARE CAPACITY LEVEL?

A. No. Verizon claims that a minimum 15% margin of spare capacity is needed to allow for efficient copper feeder operation, administration and management.

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[34] If compounding were taken into account, the real numbers would be 464 lines or 788 lines. For simplicity's sake and because of our otherwise extremely conservative approach, we have ignored this small effect of compounding.

[35] If the relief job were completed when utilization was 99%, utilization after relief would decline to 84%. Moreover, if only three years of spare capacity were provided of a route with 99% fill, utilization would decline to 90%.

There is no sound basis for this conclusion. As explained above, both standard industry guidelines and Verizon's own guidelines call for relief jobs that provide three to five years of spare capacity and then call for relief to occur prior to critical exhaust. Despite Verizon's assertion to the contrary in this proceeding, standard industry practice does not call for "administrative spare" beyond that which is required in the guidelines. In fact, there is no reference to any such minimum 15% spare margin in Verizon's Engineering Guidelines and Outside Plant Engineering Reference Manual produced in discovery in this case. Verizon's reliance on a so-called mandatory "administrative spare" capacity is nothing more than a ruse to lower the utilization rate and raise costs. Moreover, Verizon's proposed low copper fill factor – that reflects a spare capacity beyond that which is required under standard engineering guidelines – would simply yield inefficient amounts of spare facilities that risk technical obsolescence if they are not used over the facility's life cycle.

Q. DO YOU AGREE WITH VERIZON'S ANALYSIS REGARDING THE EFFECT OF BREAKAGE ON THE COPPER FEEDER UTILIZATION RATE?

A. No. Verizon claims that "breakage," or an increase in cable size caused by cable manufacturing constraints, automatically lowers the copper feeder utilization rate.[36] Although breakage does occur, it should have less of an effect than Verizon indicates. The "uncommitted pairs" that result from breakage can be left

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[36] Verizon Cost Panel Testimony at 106.

at points in the network where they can be utilized when new relief jobs occur, for example. Thus, over time, these pairs should be used. Moreover, the effects of breakage are already accounted for in the three-to-five year reinforcement guideline. For example, an engineer may not be able to relieve a feeder route with exactly three years of spare capacity because the smallest cable that would provide at least three years of spare capacity would actually provide four years of spare capacity. The engineer would then provide four years of spare capacity. But he would still act within the guideline.

Q. DO YOU AGREE WITH VERIZON'S ASSERTION THAT DEMAND PEAKS LOWER THE UTILIZATION RATE?

A. No. Verizon claims that "[m]aintaining a margin of available facilities necessary to accommodate unexpected demand peaks efficiently reduces the average utilization of network capacity.[37] However, the demand fluctuations that Verizon describes are part of everyday occurrences in the outside plant and are already engineered into the feeder cables. Moreover, standard industry practice requires that the plant must be clearly monitored and replenished in sufficient time to preclude any service delays.

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37 *Id.*

Q. DO YOU AGREE WITH VERIZON'S ASSERTION THAT THE DEMAND GROWTH THAT CAUSES CABLES TO EXHAUST AND REQUIRE RELIEF RESULT IN A LOW UTILIZATION RATE?

A. No. Verizon states that "demand growth" causes cables to exhaust and require relief. Verizon then concludes that the continual relief efforts result in utilization rates distributed across some "utilization continuum."

Verizon is mistaken at two levels. First, as explained above, growth in future demand cannot, from a costing perspective, increase the capacity costs properly attributed to current ratepayers. Second, Verizon is mistaken even from an engineering perspective. Although the process cycle from relief to exhaust of facilities does occur, to insinuate, as Verizon does, that that process somehow results in an overall low utilization rate is incorrect and misleading. While it is reasonable to expect that some cables and routes will be reaching critical exhaust while others will have just been replenished, as we have discussed above, this simply means that while some cables and routes will have close to 100% utilization, others – those that have just been relieved – will have three year to five years of spare capacity. Even using the five year figure, the minimum utilization of a route assuming a 3% growth rate on each route will then be 82% and the average will be far higher.

Q. DOES VERIZON'S CLAIM THAT THE 56% FIGURE REPRESENTS ITS ACTUAL UTILIZATION RATE COMPORT WITH YOUR EXPERIENCE?

A. No. In the experience of Mr. Riolo, it is conservative to assume an 80% utilization rate. In addition, if Verizon's utilization rate is really 56%, this would show that Verizon is acting inefficiently. With an average network growth rate of

3% per year, Verizon's 56% utilization rate allows for almost 15 years of growth without the average route in its plant needing any relief. There is no need to provide so much excess capacity. As explained above, if Verizon were following industry standard guidelines or its own guidelines, only three to five years excess capacity would be provided and utilization would be at least the 80% that we have estimated.

Q. IS THERE ANYTHING ELSE WRONG WITH VERIZON'S ASSESSMENT OF UTILIZATION OF COPPER FEEDER?

A. Yes. Verizon further states that the "[t]he smaller the number of units that are actually in service (*i.e.* the lower the utilization) ... the greater is the fraction of the cost of the facility that must be assigned to each filled unit" (emphasis added).[38] Verizon includes defective pairs as non-utilized pairs. But if Verizon acted efficiently there would be few defective pairs in its network. Pairs are not defective when they arrive, and there is no reason that many defective pairs should exist. In any event, in a reconstructed network with brand new copper feeder, there would be few defective pairs.

The data in Verizon's LART Report that is included in its cost study reveal that 429,639 or 6.3% of the cable pairs in Verizon's Distribution Areas ("DAs") are defective. A reconstructed network would not have defective pairs. Because Verizon's copper utilization rate excludes the defective pairs, it is plainly

[38] Verizon Cost Panel Testimony at 36.

evident that Verizon's copper feeder utilization rate is understated by that same margin.

3. RT PLUG-IN UTILIZATION

Q. WHAT IS A PLUG-IN CHANNEL UNIT?

A. A plug-in channel unit is used with Digital Loop Carrier (DLC). DLC systems are deployed to transport calls to and from individual customer signals more efficiently from the Remote Terminal equipment in the vicinity of the customer to the Central Office. As its name implies, the carrier is digital in nature, whereas the signal originating at the customer location is analog. For this reason, the analog signal from the customer's cable pair is converted to a digital signal at the interconnection of the cable pair to the DLC electronics. The conversion takes place at the plug-in channel unit.

Q. VERIZON CLAIMS THAT THE APPROPRIATE FORWARD-LOOKING UTILIZATION RATE FOR DLC SERVICE PLUG-INS IS 80%. DO YOU AGREE?

A. No. Since these channel units are relatively costly but easy to transport and install, prudent inventory control must be used to manage these assets properly. There is no reason to have a significant number of idle units when each unit is expensive and when units can easily be installed if new ones are needed. **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** Thus, for example, a DLC serving 600 lines and growing at a rate of 3% annually or 1.5% semi-annually would normally be equipped with additional channel units of spare capacity of 9 lines (600 x 0.015). Since POTS channel units serve 4 lines each, a minimum of 3 cards (3 x 4 =12 lines) would be required to meet the requirements for 9 lines. The utilization rate would therefore be 98% (600/612). As a result, a utilization rate of 90% is reasonable and achievable by Verizon on a forward-looking basis.

Q. VERIZON SUGGESTS THAT THE MAXIMUM THEORETICAL UTILIZATION RATE FOR PLUG-INS IS 90%.[39] IS THAT TRUE?

A. No. It is costly, inefficient, and wholly unnecessary to maintain the channel unit plug-in capacity that Verizon recommends. Even Verizon concedes that channel units are easily installed.[40] There is no reason that a rate well above 90% could not theoretically be achieved. Moreover, Verizon's unacceptably low 80% channel unit plug-in fill factor means that it is advocating the maintenance of 20% spare capacity for channel unit cards that will simply sit on DLC RT shelves. Assuming an annual 3% growth in second lines, Verizon's recommended plug-in fill factor means that there would be 7 years of idle spare plug-in cards. In view of the rapid advances in electronic chip technologies, these spare channel units could well become obsolete before they are ever used. Additionally, Verizon's definition of utilization is wrong. The service plug-ins that are left at recently vacated-premises should be counted as cut-throughs or idle assigned units in the numerator of the fill factor ratio. Thus, contrary to Verizon's claim, customer churn would not yield a reduction in the fill factor. In any event, Verizon has not

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39 Verizon Cost Panel Testimony at 108.

40 Verizon Cost Panel Testimony at 107.

shown that an efficient firm in a competitive market would leave a significant number of plug in units in place in unoccupied units.

Q. VERIZON CLAIMS THAT SUFFICIENT CAPACITY TO ACCOMMODATE SHORT-TERM GROWTH DEMAND PEAKS WOULD YIELD REDUCED LEVELS OF PLUG-IN EQUIPMENT UTILIZATION. IS THAT TRUE?

A. No. The 6 months supply of spare channel units recommended in Verizon's own engineering guidelines is designed to accommodate service demands. Service demands include what Verizon euphemistically refers to as "short-term growth" and "peak demands."

Q. COULD YOU SUMMARIZE THE BASIS ON WHICH YOU CHANGED THE RT PLUG-IN UTILIZATION?

A. The adjustment was made based on the fact that plug-in equipment capacity, unlike other components of the outside plant facility, is readily expandable. Lightweight, easily transportable, and installable plug-ins are installed on a regular basis to handle 6-months' worth of growth. At 3-percent annual growth, this would amount to justification for a 98.5-percent fill factor. Thus we believe that 90 percent is conservative.

4. RT COMMON ELECTRONICS UTILIZATION

Q. THE VERIZON PANEL REFERS GENERALLY TO "R.T. COMMON ELECTRONICS." WHAT ARE "COMMON ELECTRONICS"?

A. The term "common electronics" as used by Verizon Panel in this proceeding is misleading. When the Verizon Panel discusses "common electronics,"[41] it appears to refers only to the Litespan 2000 RT Channel Bank Assembly (CBA). But in addition to the Channel Bank Assembly, the Litespan 2000 RT also includes a Common Control Assembly (CCA). Despite this misnomer, the Verizon cost model appears appropriately to include both the common control assembly and the channel bank assembly in apportioning costs for common electronics.

Q. FOR CLARITY, WOULD YOU DESCRIBE THE TWO MAJOR COMPONENTS OF LITESPAN 2000 RT?

A. Yes. The Common Control Assembly is the basic unit that includes the common electronics used to provide DLC. It contains, for example, those electronic plug-in cards that are needed to serve all of the individual lines, such as the Common Optical Group.

The Common Control Assembly can support up to nine Channel Bank Assemblies. The Channel Bank Assembly houses up to 56 channel units (plug-ins), along with a pair of redundant controller cards, three load sharing power supplies and four auxiliary modules. The plug-in units provide service to

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[41] Verizon Cost Panel Testimony at 103

individual lines, and the utilization rate for those units has been discussed separately above.

Q. HOW DOES VERIZON DETERMINE ITS UTILIZATION RATE FOR COMMON ELECTRONICS?

A. Verizon appears to determine the utilization rate for common electronics by simply assuming this utilization rate would be the same as that for copper feeder, which Verizon states is 56.9%. As noted above, Verizon significantly understates the rate for copper feeder. Moreover, the utilization rate for common electronics should be higher than that for copper feeder. Common electronics can be installed much more quickly than copper feeder. The equipment can be purchased pre-assembled at the factory. Thus, the equipment can be installed shortly before the capacity of the existing equipment is reached.

Q. ARE THERE OTHER FLAWS IN THE APPLICATION OF THE VERIZON MODEL TO "COMMON ELECTRONICS"?

A. Yes. The Verizon model apportions the investment associated with the "common electronics" across only POTS loops. Additionally, the model assumes that a 56.9% utilization rate adjustment should be applied based on Verizon's embedded network. The model assumes that the embedded network design is forward-looking. Moreover, the model incorrectly assumes that the minimum size DLC unit is a 224 line equivalent unit.

Q. SHOULD THE VERIZON MODEL APPORTION THE INVESTMENT ASSOCIATED WITH THE "COMMON ELECTRONICS" ACROSS POTS LOOPS ONLY?

A. No. Although Verizon contends that capacity must be relatively low as a result of breakage, services other than POTS services, such as ISDN and DS1 loops, will also utilize the RT common equipment, increasing utilization levels. The "common electronics" as defined by the Verizon model serve a myriad of services that are provisioned over DLC systems, including Special Services and ISDN. Accordingly, it is wholly inappropriate to apportion all of these investment costs over only 2 wire POTS loops, as the Verizon model does, and assess the utilization rate for the common electronics as if they were only used for 2 wire POTS loops.

Q. CAN THE EMBEDDED NETWORK BE CONSIDERED FORWARD-LOOKING FOR THE PURPOSE OF APPORTIONING "COMMON ELECTRONICS"?

A. No. Verizon's assumption that an entire Litespan 2000 unit often will have to be used to serve a relatively small number of customers assumes the current groupings of customers in its embedded network. Under the scorched-node assumption of TELRIC, a new entrant is not bound by existing UAA or DA boundaries. Rather, UAAs and DAs will be redefined to produce grouping sufficiently large to maximize RT common equipment utilization.

By contrast, the patchwork embedded network design has evolved over a number of decades under a variety of circumstances. Further, local engineers, pursuant to vintage guidelines, designed the network to serve an ever-shifting customer base. The net result, the existing embedded network, was planned based on the judgment of numerous individual engineers. This often resulted in the creation of UAAs and DAs which feed into small SAIs. A forward-looking network would use larger SAIs. **[BEGIN VERIZON PROPRIETARY]** *** **[END VERIZON PROPRIETARY]** If large SAIs were used, there would be far fewer instances in which an RT DLC system served a small number of customers and utilization would be significantly higher.

Q. HOW DOES THE VERIZON MODEL'S SELECTION OF A 224 LINE CHANNEL BANK ASSEMBLY AFFECT THE DLC "COMMON ELECTRONICS" INVESTMENT?

A. The common equipment utilization levels Verizon is able to achieve in its cost study are driven, in part, by assumptions relating to the capacity of the common equipment assumed to be deployed in each DA. The Verizon study assumes a minimum RT size of 224 lines. As we explained above, many of the DAs served by Verizon on DLC include only a handful of lines. Serving these with 224-line capacity DLC's results in utilization levels for that expensive equipment that approach zero. A more realistic forward-looking design would provision small DA's with 96, 48, or even 24-line capacity RTs, thereby improving overall DLC utilization. Verizon's selection of a 224-line unit results in lower utilization and higher cost allocation. Verizon-Virginia's Litespan 2000 Planning Guidelines suggest using a 96 line unit that could significantly increase utilization for small line count areas. Moreover, there are a number of DLC products used in the industry that efficiently serve smaller line count areas. A typical small line size unit and its cost is included in Mr. Riolo's Direct Testimony.

Q. IS THE UTILIZATION FACTOR OF 56.9% FOR "COMMON ELECTRONICS" CORRECT?

A. No. Although there is no definitive way to adjust Verizon's proposed utilization rate, it seems reasonable to adjust Verizon's 56.9% estimate to 80% to take into account the mistaken assumptions that form the basis for Verizon's estimate.

5. CONDUIT UTILIZATION

Q. DOES VERIZON APPLY A UTILIZATION FACTOR TO ITS CONDUIT INVESTMENT?

A. Yes. Verizon inappropriately applies a duct utilization factor to conduit investment developed within the LCAM.[42] The utilization factor used by Verizon is **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]** and is based on Verizon's calculations of the ratio of conduit duct occupied to conduit duct available in its embedded network. Application of this embedded utilization factor overstates forward-looking costs.

Q. WHY IS THE APPLICATION OF A CONDUIT DUCT UTILIZATION FACTOR INAPPROPRIATE?

A. Verizon's cost study substantially inflates the cost of conduit by using a completely unjustified duct utilization factor of **[BEGIN VERIZON PROPRIETARY] *** [END VERIZON PROPRIETARY]**. This factor fails to consider that so much spare conduit capacity is not needed in a forward-looking environment and that other assumptions within Verizon's cost model also provide for spare capacity in the underground facility.